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RESEARCH PLAN

ON

Enhancement in the Observations and Control on Road Side Area of Vehicular Communication System using Machine Learning with Fragment Processing

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INTRODUCTION

The idea of forming an ad-hoc network of mobile nodes dates back to DRAP packet radio network Days (1973-1987). Interest within the IETE was also growing as a new working group MANET, whose charter is to develop a solution framework for routing in ad-hoc network. After this DSDV (1994) algorithm proposed which is effective for creating ad –hoc network for small population of mobile nodes. But it is a fairly brute force approach. With the goals of minimizing broadcast and transmission latency AODV is designed. AODV does not dependent specifically on particular aspects of the physical medium across which packets are disseminated. Its development has been motivated by limited range broadcast media. After this linage of algorithms proposed like as DCA, (LID/HD →→ID), DMAC, GDMA, MDMAC, DBC, CCA, K-hop, ALM, Sp-cl. PPC, UF, TBC, FLBA, UOFC, MCTC, NMCS, DMCNF, etc [1].

Recent advancements in vehicular communication technologies and the increase in the number of road accidents have led to the development of transport safety approaches in intelligent transportation systems (ITS) [1]. The ITS, aiming to improve the safety and efficiency of transportation systems, supports two types of wireless communications: long range and short-range. Long-range communication mainly relies on the existing infrastructure networks, such as cellular networks. Short-range communication, on the other hand, is based on emerging technologies such as IEEE 802.11 variants, and forms an ad-hoc network that comprises mobile vehicles and stationary roadside equipment's, collectively referred to as vehicular ad-hoc networks (VANETs) [2]. In VANETs, vehicles are equipped with wireless sensors and on-board units that enable wireless connectivity among them [3]. VANETs are considered as a sub-class of mobile ad-hoc networks (MANETs), due to some similar characteristics they possess such as infrastructure independence, self-organization and management, low bandwidth and short radio transmission range. However, existing MANET routing protocols cannot be applied directly in VANETs, and when deployed in VANET environments result in poor route convergence, low communication throughput and frequent route disruptions. This is mainly due to the high mobility of vehicles and the dynamic network topology of VANETs [2].

Other distinguishing characteristics of VANETs from MANETs are as follows:

1) The movement of vehicles is limited to road topology

2) The vehicles can afford significant computing, communication and sensing capabilities

3) The vehicles can provide continuous transmission power themselves to support these functions.

In VANETs, network topology is highly dynamic due to fast movement of vehicles, and topology is often obstructed by road structure. Vehicles are likely to encounter many obstacles such as traffic lights, buildings, trees, and road junctions, which result in poor channel quality and connectivity. Therefore, protocols developed for traditional MANETs fail to provide reliability, low latency, and high throughput performance in VANETs.

A. APPLICATIONS OF VEHICULAR Ad-hoc NETWORKS

1) SAFETY

Road safety applications send warning messages to drivers about dangerous situations in order to make driving safer. Serious situations may include dangerous road features, e.g. curves, abnormal traffic and road conditions, and danger of collision [4].

2) PUBLIC SERVICE

These applications support the work of public services such as police, ambulance and other emergency units. Usage of virtual sirens or signal preemption enables the emergency units to reach their destination faster. Other public services include traffic surveillance applications such as electronic license plate [4].

3) DRIVING IMPROVEMENT

Such applications aid in improving traffic efficiency and management. Driving improvement applications update local information and street maps, thereby smoothly the vehicle traffic flow and upgrading the level of traffic coordination and assistance [4].

4) COMFORT SERVICES

These services provide infotainment applications to drivers and passengers, either by enabling passengers to communicate with each other or by offering entertainment services such as internet connectivity and media downloading. These applications are also used for commercial purposes such as advertisements and electronic toll [3].

B. COMMUNICATION ARCHITECTURE

Communication in vehicular environment as described in [4] can be categorized into four types: in-vehicle, V2V, V2I communications and vehicle to broadband cloud communication. In-vehicle communication between on-board units (OBUs) such as sensors is required inside the vehicle to facilitate various driver and public safety applications by allowing the detection of the vehicle's performance and especially driver's fatigue and drowsiness [4]. V2V takes place between vehicles and can provide a data exchange platform for the drivers to share information and warning messages so as to expand driver assistance. V2I is an interaction between the vehicle and the roadside unit (RSU), and can be used for enabling real-time traffic or weather updates for drivers and to provide environmental sensing and monitoring.

C. REQUIREMENTS

Vehicles must have a set of wireless transmitter and receiver on-board, and should be capable of performing V2V and V2I communications. They must possess the ability to disseminate information in various modes such as unicast, broadcast, multicast and geocast. Other than these requirements, security and privacy must also be satisfied. Although navigational tools such as global positioning system (GPS) and street maps are not a must, they are highly encouraged since location information would provide significant assistance in VANETs.

D. UNIQUE CHARACTERISTICS OF VANETs and RESEARCH GAP

1) MOBILITY

In case of high velocity, the mutual communication window will be small (few seconds) due to small transmission range. Also, for high relative velocity, the communication system has to cope with the Doppler Effect, frequent link failures, wastage of network bandwidth, and high end-to-end (ETE) delay. For the other extreme cases (slow or no mobility), although nodes have high period of message exchange, they must deal with the problems related to high vehicular traffic density such as frequent data collision, channel fading, message dropping due to expired waiting time, and other interference problems.

2) MOVEMENT PATTERN

Node movement is not arbitrary but follows a predefined path (roads). However, different roads have different characteristics. Urban roads are denser in nature, with many vehicles, buildings and other obstacles when compared to rural and highway roads. These variations in characteristics may also pose some challenge for efficient communications.

3) TRAFFIC DENSITY

In case of low density, instead of immediate message forwarding, an advance information message dissemination using store-and-forward message must be done. Also, the same message may be repeated by the same vehicle multiple times. In case of high density, the opposite must be achieved with only selected vehicles allowed to send repeated messages. Node density not only depends on the road but also on time. Node density is usually high during day hours when compared to night time.

4) HETEROGENEITY

Nodes may be stationary, such as RSUs, or moving, such as vehicles. In addition, they may be categorized into different levels based on their application requirements. For instance, vehicles can be classified into private, authority and maintenance vehicles whereas RSUs can be those that emit data or those that are equipped with complete ad-hoc features. Also, unlike vehicles, RSUs do not require a privacy feature. Hence, a VANET system must provide services based on requirements of a node.

OBJECTIVES IN VANETs

1) SCALABILITY

The performance of the routing protocol must have minimum impact on varying number of vehicles in the network [5]. This is achievable if the protocol is capable of performing localized operations where routing decisions taken by a node are solely based on information available in its vicinity. This eliminates the need for the node to know the topology of the entire network, thereby reducing the control overhead.

2) CLUSTERING

Clustering is also major part of VANETs, which algorithm works by associating mobile nodes into groups according to same rule set and selecting a node known as cluster head. They were designed with a high emphasis on robustness of vehicular mobility. Our research on clustering can perform on CH selection strategy, precedence, Timer, Passive clustering, CH selection criteria, cluster member affiliation strategy, Gateway selection metrics [3].

3) NEIGHBORHOOD DISCOVERY

One of the elementary parts of the routing protocol is neighborhood discovery, which can be done either during route establishment or by sending one hop control messages called beacons. Usage of small periodic interval for beaconing may result in increased control overhead, while large periodic interval for beaconing implies stale neighborhood information. Hence, a proper selection of periodic interval for beaconing offering good trade-off between control overhead and updated information is required. Some schemes use adaptive beaconing based on certain characteristics of the vehicular environment such as mobility and density. Another recent and more appealing approach is the beaconless approach which involves reactive discovery of neighbors during forwarding of data packets.

4) DATA FORWARDING

Traditional ad-hoc routing protocols maintain routing tables that contain information of next hop to reach the destination based on certain criteria. Although these kinds of routing protocols have been implemented in VANETs, they result in degraded performance, especially in highly dynamic environments [6]. A possible solution to this is to route data on per hop basis, where a forwarding node routes the data packet according to its neighborhood at the exact time of forwarding the message.

5) UNEVEN VEHICLE DENSITY

The vehicular environment also faces the issue of uneven vehicle density, where some regions may have sparse traffic conditions while others may be dense [9]. The routing protocol needs to adapt to the varying traffic density conditions. In case the region is heavily congested, the protocol must be capable of finding a path offering minimum congestion. In sparse traffic conditions, a vehicle can store the message until a suitable forwarding opportunity appears. Moreover, it would be preferable to have an adaptive scheme that changes its operation mode based on the traffic condition.

6) USE OF POSITIONAL INFORMATION

Vehicles in VANET have access to positional information through navigational tools such as GPS. This information can offer significant advantages to routing solutions [10]. It is highly encouraged for routing protocols to take into account the positional information while selecting path and neighbors as these will further assist in enhancing the routing performance.

7) PREDICTION OF FUTURE POSITIONS

The constrained movement pattern and the access to positional information allow a vehicle to predict future positions. This information can assist the protocol to make efficient routing decisions. However, care must be taken in the prediction process as inaccurate information may lead to selection of a non-optimal path. The next section classifies some well-known routing protocols into various categories and gives brief description of each.

LITERATURE REVIEW

E. M. Royer and C. E. Perkins [1] present first algorithm which provides loop-free routes even while repairing broken links. It is smoothly functioning ad-hoc system with on demand routs could largely eliminate the need for periodic broadcast of route advertisement. With the goals of minimizing broadcast and transmission latency when new routes are needed, AODV (Ad-hoc on Demand Distance Vector) designed a protocol to improve upon the performance characteristics of DSDV (Destination Sequenced Distance Vector) in certain and maintenance of ad-hoc networks. It does not dependent specifically on particular aspects of the physical medium across which packets are disseminated.

Mihail l. Sichitiu and Maria Kihl [2] presents review on Inter-vehicle communication (IVC) systems from starting to 2008. These systems have the potential to radically improve the safety, efficiency, and comfort of everyday road travel. Their main advantage is that they bypass the need for expensive infrastructure; their major drawback is the comparatively complex networking protocols and the need for significant penetration before their applications can become effective. In this article we present several major classes of applications and the types of services they require from an underlying network. We then proceed to analyze existing networking protocols in a bottom-up fashion, from the physical to the transport layers, as well as security aspects related to IVC systems. We conclude the article by presenting several projects related to IVC as well as a review of common performance evaluation techniques for IVC systems.

Craig Cooper et al. [3] present a survey on clustering techniques of routing of vehicular communication from starting to 2016. In Vehicular Ad-hoc Networking (VANET) network nodes are road-vehicles. And the routing protocols present challenges and opportunities due to semi-organized nature of vehicular movements subject to constrains of road geometry, rules and obstacles which limits physical connectivity. In routing protocols main problems are reliability and scalability those can be reduced by clustering. In clustering main problems are cluster head elections, cluster affiliation, cluster management, Identifies new direction, determine recent trends in design of these algorithms, Improve clustering performance, review of methodologies for validating clustering performance and identifies the lack of realistic vehicular channel modeling. All these problems are discussed in this survey with the approaches of solution.

Nidal Kamel et al. [4] present a survey which can be reiterated that the inclusion of cross-layer information while routing plays a significant role in improving the performance of a routing protocol. However, the appropriate selection of routing parameters from different layers still remains an open issue, along with the elementary cross-layer design issues usually experienced in all kinds of wireless networks. Geographic routing appears to be more promising approach as compared to traditional topology based routing, where the use of location information offers an additional

advantage for achieving superior performance. However, a routing protocol designer need to consider the trade-offs that exist between various routing approaches. The routing approach must cope well with the challenging characteristics and dynamic network topology of the vehicular environment. Overall, the concept of efficient routing in Vehicular Ad-hoc networking still remains a key and widely open research issue.

Keita Emura et al. [5] propose a road-to-vehicle communication system via group signatures with time-token dependent linking (GS-TDL), and demonstrates using qualnet network simulation that our algorithm fits well for road-to-vehicle communication systems. This system not only has good performance but also supports the revocation property which is essential in real systems. It is particularly worth noting that no vehicle is involved in the revocation procedure and the signing/verification costs do not depend on the number of revoked vehicles.

Yong Hoon Kim et.al.[6] proposed a model which is able to capture the dynamics of information flow and traffic flow in an integrated formulation that circumvents key analytical and numerical challenges. Results from computational experiments demonstrate the effectiveness of the proposed model and its ability to describe the dynamic characteristics of information flow propagation along with the traffic flow dynamics.

Wuwen Lai et. al.[7] propose an average packet loss rate (PLR) analysis model taking into account the above three factors. However, the closed-form expression for the average PLR is intractable mainly due to the multiple integral of the joint distance distribution integrating with the channel conditions and vehicle mobility. Multi-hop relay can effectively improve the average PLR of vehicular ad hoc networks within a particular zone of interest. Challenges arise from analyzing the average PLR affected by distributed relay selections, which depend on the mobility of vehicles, the wireless channel conditions, and media access control (MAC). An explicit expression for the upper bound of the average PLR is obtained by using Taylor series expansion, Holder's inequality, and the relay probability relaxation, which can facilitate the selection of the parameters at the physical and MAC layers for a better PLR. Simulation results validate our analyses.

Houbing Song et. al.[8] present an intelligent naïve Bayesian probabilistic estimation practice for traffic flow to form a stable clustering in VANET, briefly named ANTSC. They proposed improved routing by employing awareness of the current traffic flow as well as considering the blend of several factors, such as speed difference, direction, connectivity level, and node distance from its neighbors by using the intelligent technique. This technique has proven to be more strong, stable, robust, and scalable than existing ones.

RESEARCH GAP

One possible future application is to collect drivers behavioral and physiological information recorded by sensors located at various parts of the driver's body through in-vehicle communication, and then, transmits the data to a monitoring center using vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications. The driver's behavioral information, such as facial expression and blink rate, and physiological signals, such as heart-rate variability and electroencephalogram (EEG) signals, give vital health related information about the driver's fatigue and drowsiness condition. Warning signals can be sent to both the driver and the authorities in case of driver's abnormal health conditions. Apart from this, other safety related applications, such as overtaking vehicle warning, emergency vehicle warning, hazardous location notification and control loss warning, are described. Since these applications are critical, their messages should have a deep penetration across the entire network and must be reliably delivered within a short time. Authors in [4] highlight one such adaptive beaconing strategy, where the numbers of beacon propagating nodes between two intersections are significantly reduced. However, an intersection independent adaptive beaconing scheme would provide a global solution to beacon overhead and is an open issue for future research.
We set RSUs in appropriate locations, e.g., at traffic lights of crossroads, in the middle of a long road, etc. However, we may consider alternative installation locations for RSUs that may better reflect real environments [5].
In [8] presented a traffic movement based stable clustering algorithm using the Naïve Bayesian method, with the aim of creating stable clusters in urban scenarios. The parameters of the vehicles such as traffic weight, speed, cluster size, connectivity level, direction and vehicle distance are used in our technique for cluster head selection. The cluster head will be selected from the lane having the heaviest traffic flow, aiming to enhance the stability of the cluster as well as the lifetime of the cluster head. The proposed algorithm may be compare with its updated algorithms and may increases the stability and lifetime of both the cluster and the CH.

Hence the research gapes are:-

There is requirement to enhance Reliability and Scalability of VCS algorithms.
Currently, only traffic congestion is included as a RSA event. New events are also required to be predicted by regular RSA information to the vehicles.
Enhancement in prediction of RSA event by updating regular RSA information to the vehicles.
Enhancement in real time prediction of open loop and close loop solution.
Enhancement in transmission and receiving capability of data of OBU, CH, RSU and IDU.

RESEARCH OBJECTIVES

With the aim of contributing towards the deployment of secure and efficient routing protocol for Vehicular Ad-hoc Networks the following objectives are proposed for my research work:-

Objective 1: To analyze clustered Vehicular Communication System using wireless connections for reliability and scalability.

Objective 2: To propose an algorithm for improving observations and control of nodes in Road Side Area of Vehicular Communication System.

Objective 3: To propose a strategy for the performance enhancement of OBU, CH, and RSU with trained Neural Network.

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APPROACH / METHODOLOGY INTENDED TO BE ADOPTED

The proposed work will be conducted on the simulator like Qualnet, ns-2 etc.

Objective 1: To analyze clustered Vehicular Communication System using wireless connections for reliability and scalability.

As for the development of the energy efficient routing protocol capable Vehicular Ad-hoc Network, life time of the sensor node is to be improved therefore first we have to go through different factors like data collision etc. which are directly or indirectly affecting the energy consumption of the node. Proper simulation results will be obtained and compared for the same.

Objective 2: To propose an algorithm for improving observations and control of nodes in Road Side Area of Vehicular Communication System.

To increase the life time of the cluster head either we have to develop a robust routing protocol which will improve connective etc. and will result in robust connection or we have to look for an alternate cluster head for the selection in available coverage range. This will increase the life time of the cluster head for this various routing harvesting approaches. This can only be done by comparing the simulation results by varying the existing equations or parameters.

Objective 3: To propose a strategy for the performance enhancement of OBU, CH, and RSU with trained Neural Network.

Once the simulation results of above mentioned objectives are analyzed and compared then a set of rules or algorithm will be development either for efficient routing or for searching for an alternate source of energy that is harvesting energy for increasing the lifetime of the sensor nodes. A new clustering technique can be proposed. After the

analysis and comparison of various clustering techniques as per current situations, this may be helpful for designing a new routing protocol.

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